



The Kefalonia Transform Fault: a STEP in the making

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Vertical tears in subducted slabs have recently been recognized in the majority of the global subduction zones. Surprisingly, the slab tears evolved into Subduction-Transform-Edge-Propagators (STEPS) in only very few regions, i.e. the conditions under which STEPs form are special. The presence of a vertical tear in a slab seldom leaves a clear tectonic imprint in the crust of the overriding plate. This is different for STEPs: their footprint in the tectonics of the Mediterranean and Pannonian basins attest to the relevance of STEP activity. It is therefore relevant to constrain the conditions that facilitate STEP initiation. We therefore study a candidate region for STEP initiation in the western Hellenic Subduction Zone: Govers and Wortel (2005) suggested that the offshore Kefalonia Transform Fault and its on-land continuation constitute a STEP Fault, which inspired regional studies of the geometry of the shallow (50-200 km depth) slab, but none of these were conclusive.

We investigate the shallow western Hellenic slab using a recent full-waveform inversion model which both captures details of crustal and upper-mantle structure, yielding constraints in the depth interval from 10–200 km where lithosphere–mantle interactions have tectonic expressions. When we combine these tomographic images of the slab morphology with focal mechanism solutions we get a complete picture of slab gap underneath the northeastern (on-land) continuation of the Kefalonia Transform Fault and the Gulf of Corinth. We illustrate a deeper horizontal tear, which is overlain by a vertical tear, located adjacent to the slab edge.

Geological/tectonic studies for the overriding plate noted an acceleration and disruption of the overriding plate by a Central Hellenic shear zone since the late Pliocene. Its present-day expression is a clear contrast in the active deformation of the overriding plate along a zone extending from the KTF. The timing of this acceleration in surface deformation agrees with the depth extent of the tear in the slab. We conclude that the Kefalonia Fault in the Ionian slab is an initiating STEP fault, and we discuss the reason why it became more than a slab tear.